REMARKS

In sections 4 and 5 of the Office Action, the Examiner rejected claims 60-62, 64, 65, and 70-72 under 35 U.S.C. §112, first paragraph, as failing to comply with the enablement requirement. Specifically, the Examiner asserts that there is no disclosure to support the limitation of independent claim 60 of generating a reliability factor based upon a difference between at least two of the received signal values, wherein the reliability factor is a measure of reliability of the decoding.

More specifically, the Examiner asserts that, while there is description that the reliability factor is based upon a difference between the absolute value of the Walsh Transform output peak having the largest value and the Walsh Transform output peak having the next largest value, there is no description that the reliability factor is based upon a difference between at least two of the received signal values.

Still more specifically, the Examiner asserts that the Walsh Transform output peaks are decoded values, not received values.

However, the Examiner admits that the Walsh Transform output peaks are values. The Examiner must

also admit that the Walsh Transform output peaks are derived from a received signal. Therefore, it is not illogical to use the term "received signal values" to refer to the Walsh Transform output peaks (and to alternatives), because these values are based on the received signal.

The Examiner may in essence be objecting to the breadth of the term "received signal values." However, as pointed out above, there is a logical connection between the values used to generate the reliability factor and the received signal, and this logical connection supports the use of the term "received signal values." Moreover, if the breadth of this term is at issue, the issue is one of novelty and obviousness, not enablement.

Of course, the issue of novelty and obviousness is made more difficult because not any received signal values will serve to support a 102 or 103 rejection of independent claim 60. The received signal values also must be of a nature to permit generating a reliability factor that is a measure of decoding reliability.

This added difficulty of supporting a 102 or 103 rejection of independent claim 60 is not sufficient reason to justify an enablement rejection.

Indeed, the invention of independent claim 60 is fully enabled because the present application discloses how to use received signal values (i.e., in one but not necessarily the only embodiment, Walsh Transform output peaks) to generate a decoding reliability factor.

Thus, while the Examiner may have trouble dealing with the term "received signal values," this difficulty is not based on a lack of enablement.

However, in case the Examiner particularly objects to the use of the words "received signal" to described these values, applicants have amended the claims to change the terms "received signal values" and "received signal value" to simply "values" and "value," respectively

Accordingly, claims 60-62, 64, 65, and 70-72 comply with 35 U.S.C. §112, first paragraph, because they are enabled.

<u>In sections 7 and 8 of the Office Action</u>, the Examiner rejected claims 60, 61, 64-66, 68-71, 73, 75, 77-79, 81, 83, and 84 under 35 U.S.C. §103(a) as being unpatentable over Gosse in view of Webster and further in view of Iwamatsu.

<u>Gosse</u> in connection with Figure 1 describes a minimum mean square error (MMSE) decision feedback

equalizer (DFE) having a feed forward filter 10 and a feedback filter 16. The output Y(k) of the feed forward filter 10 is applied to a summer 14, which also receives an output of the feedback filter 16. The summing node 14 combines these signals as a combined signal g(k) which forms symbol-level soft outputs 17. Traditionally, the output of the summer 14 comprises equalized symbols.

The feedback filter 16 provides its output based on the past history of processed input signals. The past history is provided by storing in a memory 18 the symbol decisions leading to a state S, based on branch metrics comparisons performed by a branch metric comparator 19. The inputs to the branch metric comparator 19 are the branch metrics provided by a branch metric calculator 20 which, with the branch metric comparator 19 and the memory 18, implements a Viterbi algorithm. Thus, the memory 18 stores a temporary vector of a small set of (intermediate) hard decisions FB_s. The memory 18 feeds this vector to the feedback filter 16.

The signal Y(k) is also applied to the branch metric calculator 20 which also receives a value d_js multiplied by the output s_0 of the feedback filter 16. The value d_js represents a possible value for the symbol presently being calculated and corresponds to a possible

transition in a trellis 22 of the Viterbi algorithm. The Viterbi algorithm calculates branch metrics for each possible predecessor state of each arrival state in the trellis. For a given arrival state S_0, the most likely predecessor j_0 is chosen, and the symbol $(d_j0)(s_0)$ corresponding to the transition is stored in the path history of the state S_0 and in the feedback register.

Coset slicing is performed to determine the closest 8-PSK symbol, d, to the equalized signal $e_s(t)$.

Figure 5 is a block diagram of an iterative equalizer. A received signal is applied to a feed forward filter 42 of a decision feedback equalizer 40. The output of the feed forward filter 42 is applied to a summer 44 whose output is equalized symbols. The output of the feed forward filter 42 is also applied to a decision module 46 and to a soft bit generator 48. The decision module 46 may be a Viterbi processor. The output of the decision module 46 is applied through a switch 50 to a feedback filter 52 of the decision feedback equalizer 40. The output symbols of the feedback filter 52 are provided to the summer 44.

The equalizer of Figure 1 can be used for the equalizer 40 of Figure 5.

The soft bit generator 48 generates bits from the equalized symbols, and these bits are deinterleaved at 54. The deinterleaved bits are decoded by a channel decoder 56 to provide a decoded output.

In a first iterative cycle, the switch 50 is in the position shown in Figure 5 and the decision feedback equalizer 40 functions conventionally. In every subsequent iteration, the switch 50 is moved to its alternate position to disconnect the feedback filter 52 from the decision module 46, to remove the incoming data stream from the summer 44, and to apply a new signal to the feedback filter 52.

This new signal is produced by re-encoding at 58 the decoded bits from the decoder 56, re-interleaving the re-encoded bits at 60, and mapping the re-interleaving and re-encoded bits back to symbols at 62.

Buffers 64, 66, and 68 store the outputs of the feed forward filter 42, the de-interleaved bits from 54, and the re-interleaving and re-encoded bits from 60, respectively.

A first test for convergence is made by a stopping rule 70 to determine whether the iterative process should stop or continue, thus eliminating unnecessary iteration. Accordingly, at iteration i, if

the re-encoded bits at the output of 58 differ from the de-interleaved bits at the output of 54 by less than θ_{low} bits or by more than θ_{high} bits, the iteration is stopped. Different values of θ are necessary for different codes and different maximum numbers of iterations.

Accordingly, the stopping rule 70 uses the number of different bits between the re-encoded bits at the output of 58 and the de-interleaved bits at the output of 54 as a measure of channel quality. If there are many different bits, then the channel is probably very poor, and further iterations are useless. If there are only a few different bits, then the channel is probably very good, and further iterations are again unnecessary.

If the re-encoded bits at the output of 58 do not differ from the de-interleaved bits at the output of 54 by less than θ_{low} bits or by more than θ_{high} bits, a stopping rule 72 is performed. According to the stopping rule 72, iterations are stopped if no re-equalization is necessary. Re-equalization is necessary if and only if the re-interleaved and re-encoded output of the interleaver 60 at iteration i is different from that of the previous iteration i-1.

Thus, the stopping rule 72 monitors the change in the re-encoded and re-interleaved sequence from one iteration to the next. If there is no change, no further iteration is necessary because further error correction is impossible. If any of the bits of iterations i and of iteration i-1 are different, further iteration is necessary and a new iteration is commenced. Also, if there is a difference between iterations i and i-1, only the bits that differ are used as the next input for the re-equalization process.

Independent claim 60 - As can be seen, there are a number of differences between independent claim 60 and Gosse.

First, contrary the requirements of independent claim 60, Gosse does not generate a reliability factor based upon a difference between at least two received signal values where the received signal values are decoded values. Instead, the stopping rule 70 of Gosse operates on encoded bits upstream of the decoder 56 and downstream of the encoder 58, and the stopping rule 72 of Gosse operates only on encoded bits downstream of the encoder 58. Neither stopping rule operates on decoded bits.

Second, Gosse does not disclose the generation of a reliability factor as a measure of decoding reliability. To the contrary, Gosse specifically states that the stopping rule 70 measures channel quality. Moreover, since the stopping rule 72 monitors the change in the re-encoded sequence in order to determine if re-equalization is necessary, it can safely be concluded that the stopping rule 72 measures the effectiveness of equalization. This distinction underscores the first difference between independent claim 60 and Gosse, i.e., that Gosse does not disclose generating a reliability factor based upon a difference between at least two decoded received signal values.

Third, applicants would like the Examiner to explain how the received input symbol stream of Gosse is the code vector of independent claim 60. Certainly, symbols are received in Gosse and, while it may be argued that a plurality of symbols can form a vector, there is no disclosure in Gosse that a vector comprising plural symbols is decoded as a vector. Instead, there is much description in Gosse to support a conclusion that the decoding is performed on individual symbols and not on groups of symbols.

Indeed, the soft bit generator 48 generates bits from each symbol output of the summer 44. The soft bit generator 48 is sort of a reverse mapper since it is the reverse of the symbol mapper 62 in the feedback loop. As an example, a 2/3 trellis encoder in a digital television convolutionally encodes two bits of input data as three convolutionally encoded bits and a symbol mapper maps the three convolutionally encoded bits as a symbol.

Thus, the soft bit generator 48 de-maps the symbol as three convolutionally encoded bits and the decoder 56, which is described in Gosse as a convolutional decoder, convolutionally decodes the three convolutionally encoded bits back to the original two bits of input data.

As can been, Gosse does not suggest receiving or decoding code vectors.

The Examiner points to column 2, lines 8-26 of Gosse for a disclosure of a received code vector. Column 2, lines 8-26 of Gosse state that the number of states can be reduced by partitioning the constellation of symbols, that the reduced state is a vector of indexes of symbol subsets, that the advantage of state reduction is to reduce the complexity of Viterbi-based equalizers, that the performance of Viterbi-based equalizers can be

degraded by error propagation, and that reliability of the feedback decisions made in the Viterbi stage is improved.

As can be seen from this portion of Gosse and from the description of Figure 1, the vector described in Gosse is a state vector maintained by the Viterbi algorithm and is not a received code vector.

The Examiner then points to column 3, lines 1-12 of Gosse for a disclosure of decoding a received code vector. Column 3, lines 1-12 of Gosse state that an input data stream of modulation symbols is received, that a reduced set sequence estimation algorithm is implemented to produce intermediate hard decisions based on the input data stream and on a channel reference, that the intermediate hard decisions are applied to a decision feedback filter, that soft output sequences of symbols are produced based on the input data stream, that the symbols are decoded, error-corrected, and re-encoded, and that the error-corrected soft output symbols are applied iteratively to the decision feedback filter in order to generate a channel equalized received data stream based on both the feedback soft output sequences and the intermediate hard decisions.

As can be seen from this portion of Gosse and from the description of Figure 1, Gosse does not disclose receiving and decoding a code vector. When read in context, this portion of Gosse merely states that symbols are received, intermediate hard decisions are made based on the received symbols, these intermediate hard decisions are applied to a decision feedback filter, soft outputs are produced based on the received symbols, the soft outputs are decoded, error-corrected, and re-encoded, and the error-corrected soft output is applied iteratively to the decision feedback filter in order to generate a channel equalized received data stream based on both the feedback soft output and the intermediate hard decisions.

The Examiner also points to column 3, line 65 to column 4, line 6 of Gosse for a disclosure of deriving a set of received signal values corresponding to the code vector. Column 3, line 65 to column 4, line 6 of Gosse state the input data stream is filtered by a feed forward filter to yield Y(k), that Y(k) is used to compute the branch metric, that the signal constellation is first partitioned into N disjoint subsets, that the number of states in the trellis is then N^L where L is the size of the state vector and N the number of subsets, that a

preferred choice is L=1, and that, in that case, the Viterbi machine is said to be in state s if the last transmitted symbol belongs to subset s.

This portion of Gosse refers to partitioning of the signal constellation. The signal constellation represents the set of values that the received signal can have. The signal constellation does not represent the actual values of the signal. For example, in digital television, the 8 VSB signal is said to have a constellation of 8 levels because a transmitted symbol can have one of 8 possible signal levels. It does not mean that a transmitted symbol has 8 signal levels because a transmitted symbol has only one of the 8 possible signal levels.

Thus, this portion of Gosse does not disclose that a code vector is received and decoded.

The Examiner also applied Webster in rejecting independent claim 60. However, like Gosse, Webster does not disclose generating a reliability factor based upon a difference between at least two received signal values where the received signal values are decoded values, Webster does not disclose the generation of a reliability factor as a measure of decoding reliability, and Webster does not disclose receiving and decoding a code vector.

Webster describes in connection with Figure 6 a RAKE receiver in which a received signal is coupled to a codeword correlator 31 that contains a plurality of correlators each of which is configured to apply a different one of a plurality of codewords to the received signal. A peak or largest value detector 35 selects the codeword that most closely matches the received signal as the transmitted codeword. Each codeword comprises a plurality of pseudonumber chips.

The RAKE receiver of Figure 6 includes a chip-based decision feedback equalizer (DFE) 36. The chip-based DFE 36 as shown in Figure 7 is a traditional DFE.

Intercodeword interference (ISI) is cancelled as illustrated in Figure 10. The output of a channel matched filter 33 is coupled to a positive input 101 of a summer 102, whose negative input 103 receives a post-cursor representative echo that is produced by a channel impulse response estimator 107. An output 104 of the summer 102, which represents a "cleaned-up" copy of the received codeword, is coupled to the correlator 31, the output of which is supplied to a codeword decision operator 105. The codeword decision operator 105 examines all of the M chips in a received codeword to

make a decision as to what codeword was actually transmitted.

A replica of the chip contents and phase information of the decided upon originally transmitted codeword is then synthesized in a transmitted codeword synthesizer 106. This synthesized codeword is convolved with an estimate of the channel impulse response implemented in an FIR filter 107 so as to produce a representation of the post-cursor multipath echo in the signal received by the channel matched filter 33. By applying this post-cursor echo to the differential combiner 102, the total ISI contribution in the output of the channel matched filter 33 is effectively canceled from the input to the codeword correlator 31.

As can be seen, Webster does not disclose generating a reliability factor based upon a difference between at least two received signal values where the received signal values are decoded values. In fact, all Webster actually describes is how to determine which codeword was transmitted (by use of the correlator 31). Webster shows in Figure 10 that the codeword decider 105 produces data, and Webster further states that the codeword may be phase modulated to convey information

(see paragraph 0008), but Webster does not describe how to decode the code word to recover that information.

Webster does describe the use of Walsh or Hadamard codes to select the chips that form the codeword. Webster also describes the use of a fast Walsh (Hadamard) structure as the codeword correlator to determine which codeword was transmitted. However, there is no description in Webster of actually decoding the codeword.

Moreover, Webster does not disclose the generation of a reliability factor as a measure of decoding reliability. Indeed, Webster does not describe producing decoding values that can be used to generate a decoding reliability. Also, Webster does not even mention or suggest generating a reliability factor.

Further, Webster does not disclose receiving and decoding a code vector. Webster simply does not describe the decoding of the codeword. Determining which codeword was transmitted yes, decoding the codeword no.

The Examiner points to paragraphs 0018, 0021, and 0062 of Webster.

Paragraph 0018 describes a post-cursor representative echo that is produced by estimating the channel impulse response to produce a "cleaned-up" copy

of the received codeword, a codeword correlator that decides what codeword was actually transmitted, using the codeword decision to synthesize a replica of the chip contents and phase information of the transmitted codeword, and convolving an estimate of the channel impulse response implemented in a FIR filter to produce the representation of the post-cursor multipath echo in the signal received by the channel matched filter.

The channel estimate is not a decoding reliability factor. It is simply an estimate of the channel.

Paragraph 0021 describes synthesizing the multipath channel impulse response by subtracting the respective feedback filter tap stages from the received signal downstream of each codeword correlator, implementing the codeword correlator as a fast Walsh (Hadamard) structure, and not regenerating feedback taps as each newly received codeword chip set is clocked into the correlator.

Again, the channel estimate is not a decoding reliability factor. It is simply an estimate of the channel.

Paragraph 0062 states that the quadriphase rotation outputs (+1, +j, -1, -j) of a respective

codeword are coupled to first inputs of a set of differential combiners, that these differential combiners have second inputs that receive complex correlation values for the synthesized tap path, and that the outputs of the differential combiners are coupled to a peak detector, which selects the largest real output as the actually transmitted codeword.

The largest peak is used to decide which codeword was transmitted. The codeword in not being decoded and, therefore, these peaks do not suggest a decoding reliability.

Iwamatsu similarly does not disclose generating a reliability factor based upon a difference between at least two received signal values where the received signal values are decoded values, Iwamatsu does not disclose the generation of a reliability factor as a measure of decoding reliability, and Iwamatsu does not disclose receiving and decoding a code vector.

Accordingly, because Gosse, Webster, and Iwamatsu do not disclose generating a reliability factor based upon a difference between at least two received signal values where the received signal values are decoded values, because Gosse, Webster, and Iwamatsu do not disclose the generation of a reliability factor as a

measure of decoding reliability, and because Gosse, Webster, and Iwamatsu do not disclose receiving and decoding a code vector, one of ordinary skill in the art would not have been led by Gosse, Webster, and Iwamatsu to produce the invention of independent claim 60.

Therefore, independent claim 60 is not unpatentable over Gosse in view of Webster and further in view of Iwamatsu.

<u>Independent claims 66, 73, and 79</u> - Although independent claims 66, 73, and 79 recite generating a reliability factor based upon one received signal value instead of two as in independent claim 60, it is clear from the above discussion that independent claims 66, 73, and 79 are likewise not unpatentable over Gosse in view of Webster and further in view of Iwamatsu.

Because independent claims 60, 66, 73, and 79 are not unpatentable over Gosse in view of Webster and further in view of Iwamatsu, dependent claims 61, 64, 65, 68-71, 75, 77, 78, 81, 83, and 84 are likewise not unpatentable over Gosse in view of Webster and further in view of Iwamatsu.

<u>In section 9 of the Office Action</u>, the Examiner rejected claims 62, 67, 72, 74, 76, 80, and 82 under 35 U.S.C. §103(a) as being unpatentable over Gosse in view

of Webster and further in view of Iwamatsu and still further in view of Khayrallah.

Khayrallah does not make up for the deficiencies of Gosse, Webster, and Iwamatsu.

Therefore, independent claims 60, 66, 73, and 79 are not unpatentable over Gosse in view of Webster and further in view of Iwamatsu and still further in view of Khayrallah.

Because independent claims 60, 66, 73, and 79 are not unpatentable over Gosse in view of Webster and further in view of Iwamatsu and still further in view of Khayrallah, dependent claims 62, 67, 72, 74, 76, 80, and 82 likewise are not unpatentable over Gosse in view of Webster and further in view of Iwamatsu and still further in view of Khayrallah.

CONCLUSION

In view of the above, allowance of all claims and issuance of the above captioned patent application are respectfully requested.

The Commissioner is hereby authorized to charge any additional fees which may be required, or to credit any overpayment to Account No. 26 0175.

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